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ON PROBLEM 132.

BY PROF. A. HALL, WASHINGTON, D. C.

THE integral required in this question is a special case of the one discussed by Legendre in his treatise on elliptic functions, Chap. XXVI. p. 165. Legendre shows that the elliptic integrals disappear, and that the result can be expressed in logarithmic and circular functions. His method is complicated however, and Clausen has obtained the result by the following simple substitutions. Let

$$z=\frac{x-1}{\sqrt{(x^3-1)}}:\quad z'=\sqrt{(x^3-1)}:\quad z''=\frac{(x-1)^2}{\sqrt{(x^3-1)}}:$$

Then

$$dz=-\frac{x^3-3x^2+2}{2\sqrt{(x^3-1)^3}}dx:\quad dz'=\frac{3}{2}.\frac{x^2.dx}{\sqrt{(x^3-1)}}:$$

$$dz''=\frac{1}{2}.\frac{x^4+2x^3-3x^2-4x+4}{\sqrt{(x^3-1)^3}}dx:$$

Hence

$$\frac{dz}{1-3z^2}=-\frac{1}{2}.\frac{x^2-2x-2}{x^2-2x+4}.\frac{dx}{\sqrt{(x^3-1)}}:\quad \frac{dz'}{z'^2+9}=\frac{3}{2}.\frac{x^2}{x^3+8}.\frac{dx}{\sqrt{(x^3-1)}}:$$

$$\frac{dz''}{z''^2+9}=\frac{1}{2}.\frac{(x-1)(x^3+3x^2-4)}{(x+2)(x^3+3x^2-4)}.\frac{dx}{\sqrt{(x^3-1)}}=\frac{1}{2}.\frac{x-1}{x+2}.\frac{dx}{\sqrt{(x^3-1)}}:$$

$$\therefore\quad \frac{dz}{1-3z^2}+\frac{dz'}{z'^2+9}+\frac{dz''}{z''^2+9}=\frac{bx.dx}{(x^3+8)\sqrt{(x^3-1)}}:$$

The integrations can now be performed and we have

$$\int\frac{xdx}{(x^3+8)\sqrt{(x^3-1)}}=\frac{1}{12\sqrt{3}}.\log\left(\frac{1+z\sqrt{3}}{1-z\sqrt{3}}\right)+\frac{1}{18}\tan^{-1}\frac{z'}{3}+\frac{1}{18}\tan^{-1}\frac{z''}{3}$$

$$=\frac{1}{12\sqrt{3}}.\log\frac{\sqrt{(x^2+x+1)}+\sqrt{(x-1)}.\sqrt{3}}{\sqrt{(x^2+x+1)}-\sqrt{(x-1)}.\sqrt{3}}+\frac{1}{18}\tan^{-1}\frac{3x(x-1)}{(4-x)(x^3-1)^{\frac{1}{2}}}.$$

REMARKS BY PROF. ORSON PRATT, SEN., SALT LAKE CITY, UTAH. —THE six propositions, published in the ANALYST, Vol. III, No. 6, and demonstrated in the last No., are not "presented as the basis of a theory of gravitation." They have no bearing on or reference to the *cause* of the force called gravity, or to the exploded hypothesis of an ethereal pressure, exerted in the direction of a gravitating center.

The only modification that I have given to the Newtonian theory, is the assumption that the force is not transmitted through space instantaneously, but with the velocity of light and all other solar radiations.

On the assumption that there is no resisting medium, La Place has demonstrated that the stability of the system depends on the almost instantaneous transmission of the force.

My theory is that the great ethereal ocean is a resisting medium, and that the stability of the universe must, consequently, depend upon an orbital force constantly acting, and that the gravitating force, transmitted with any given velocity must necessarily give rise to such orbital force.

In the second proposition, I have demonstrated the *only* law of ethereal density which can possibly render the system stable.

Ethereal substance, like all other matter, is subject to gravitation; therefore it must have "a density *increasing* toward the centers of bodies immerced in it." For the same cause, certain dimensions of these ethereal atmospheres or envelopes, must accompany bodies in their axial rotations.

The laws which I have demonstrated in regard to the constantly acting orbital force, are the necessary results of a still more general and univesal law, which may be expressed as follows:

Every Particle of Matter in the Universe transmits its Force to every other Particle, with the velocity of light, by virtue of which every Moving Particle exerts upon every other Particle an Aberrating Force at right angles to the connecting line, which is directly as the Mass, multiplied into the Velocity of Aberration, and inversely as the Square of the Distance from each.

[The foregoing Remarks by Prof. Pratt furnish a pertinent and sufficent reply to the suggestion we made at page 19. We embrace this opportunity to say, however, that we dissent entirely from the theory outlined by Prof. Pratt in the above remarks and in the propositions referred to.

We accept the existence of an *ether*, but such an ether as the *undulatory* theory of light requires, and, as defined by Sir John Herschel, "having inertia but not gravity." We deny that there is any evidence of the progressive motion of gravity, unless the force should turn out to be a *result* of ethereal motion which Prof. Pratt denies. We also deny that the system of the world is necssarily, or even probably, permanent, because both observation and analogy teach, we think, that systems, like individuals, have a beginning, attain their maturity, and then decay and die; the physical universe undergoing, as we believe, an infinite series of changes through every grade of organization from that of an individual plant or animal to that of a solar, or a stellar system.—Ed.]